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International Biodeterioration & Biodegradation 49 (2002) 175–178

INTERNATIONAL  
BIODETERIORATION &  
BIODEGRADATION

www.elsevier.com/locate/ibiod

## Methyl anthranilate aerosol for dispersing birds from the flight lines at Homestead Air Reserve Station

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### Abstract

The failure of traditional hazing methods to provide a lasting dispersal of birds from the flight lines at Homestead Air Reserve Station, Florida led to trials with Rejex-it<sup>®</sup> TP-40 methyl anthranilate (MA) formulation as an aerosol. A variety of civil, military and other government aircraft use the base, including combat aircraft which are particularly prone to bird airstrikes due to low altitude, high speed flights. Migrating swallows and killdeer congregate at the airfield to forage on insects, and the large numbers of birds cause restrictions in airfield operations because of potential strike hazards with aircraft. MA applied by fogger upwind of the areas to be protected was found to provide a dispersal lasting the remainder of the day. The median time from imposition of airfield restrictions on flight operations to a declaration of a low bird hazard potential was approximately 45 min, and 75% of applications resulted in removal of airfield restrictions within 1.5 h. Published by Elsevier Science Ltd.

**Keywords:** Airport hazards; Bird airstrike; Repellent

### 1. Introduction

Bird strikes with aircraft are a worldwide concern because they threaten passenger safety (Thrope, 1997), result in lost revenue and costly repairs to aircraft (Michael, 1986; Milson and Horton, 1990; Linnell et al., 1996; Robinson, 1997; Cleary and Dolbeer, 1999; Cleary et al., 1997, 1998), and can erode public confidence in the air transport industry as a whole (Conover et al., 1995). Military flights are particularly vulnerable to bird strikes because they often involve high speeds at the low altitudes where birds are also most active (Blokpoel, 1976).

Hazing and physical barriers have traditionally been used to exclude wildlife from areas (Marsh et al., 1991; Hygnstrom et al., 1994). Airfields present inherent difficulties for these methods, because exclusionary devices obviously cannot be applied for birds along flight lines without excluding aircraft, and wildlife often rapidly habituate to hazing methods, especially if they are applied in a predictable fashion (Allen, 1990).

Repellents offer another option for deterring wildlife entrance into an area. The primary component of syn-

thetic grape flavoring, methyl anthranilate (MA), has been identified to be a powerful avian irritant (Kare, 1961). It has been successfully tested as a topical repellent to deter goose grazing on grass (Cummings et al., 1991), to reduce bird damage to blueberries (Cummings et al., 1995), and to repel birds at landfills and standing water on airports (Dolbeer et al., 1993).

The physiological system that mediates oral detection of irritants also innervates the mucosae of the eyes and nasal passages (Stevens et al., 1998). Aerosol application of chemical irritants for bird management follows the same principle as tear gases used for human crowd control (Yih, 1995; Anderson et al., 1996; Stevens and Clark, 1998), and a strong irritation response by European starlings (*Sturnus vulgaris*) to aerosol bursts of MA formulations was demonstrated in research trials by Stevens and Clark (1998), with no evidence of habituation. MA fog, applied over multiple nights, has driven starlings and common grackles (*Quiscalus quiscula*) from roost sites (Vogt, 1997), and airport hangers (Vogt, 1999).

We tested application of a MA formulation by aerosol fogger on Homestead Air Reserve Station as a nonlethal means for dispersing large numbers of birds that accumulate at the airfield during migrations. Previously, hazing had not been effective at producing a lasting bird dispersal from the base for significant portions of the day. Bird conditions have

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often posed unacceptable hazards, and aircraft operations have had to be highly restricted or shut down.

## 2. Methods

### 2.1. Homestead Air Reserve Station

Homestead Air Reserve Station is situated approximately 33 km southeast of Miami, Florida, and 10 km east of the city of Homestead, Florida. The base area is flat, with an average elevation of 2.3 m above mean sea level. The airfield has one runway (NW–SE), and serves military as well as aircraft from the US Customs Miami Air Branch and general aviation. Aircraft using the base range from F-16 and F-15 combat aircraft to small propeller planes to 20–30 passenger jets. The airfield receives substantial use by fighter aircraft including weapons training deployment and several exercises each year involving joint service fighter and mission support aircraft.

The Homestead airfield faces a bird-airstrike hazard that results from large numbers of barn swallows (*Hirundo rustica*), tree swallows (*Tachycineta bicolor*) and killdeer (*Charadrius vociferus*) using the habitat at the airbase during their migrations. The spatial and temporal heterogeneity among species in migration patterns presents a year-round potential for large congregations of birds. These bird species typically do not roost on the base, but arrive in the morning as insects begin hatching, and they carry out low level foraging flights in large numbers (up to several thousand birds). When insects are not active, birds often loaf in large numbers along the runways until hatches begin.

The airfield portion of the base is mowed, but active habitat modification is not applied throughout the base. The base lies between Everglades and Biscayne National Parks, and insecticides are not generally applied for other than mosquitos.

### 2.2. Bird watch condition (BWC)

As part of standard base operations, bird activity is classified into three BWC categories for rapid dissemination of information, and for implementation of operational procedures (US Air Force, 1999). While size and location of birds are factored into BWC designations, number of birds has been the primary factor used for swallows and killdeer. BWC-Low is defined as normal bird activity on or above the airfield with a low probability of airstrike hazard. Normal flying operations are authorized under this condition. A BWC-Moderate is defined by increased bird population in locations that increase the potential for a strike. This condition results in substantial restrictions in operations and requires increased vigilance by all agencies, supervisors, and aircrews. Multiple approaches and traffic pattern activity for Air Force Reserve combat aircraft are not permitted. Formation takeoffs, approaches, and landings are prohib-

ited. BWC-Severe is defined by high bird populations on or immediately above the active runway, or other locations that represent a high potential for a strike. This condition requires supervisors and aircrews to thoroughly evaluate mission needs before conducting operations under this condition. Takeoff and landing of Air Force Reserve Command aircraft are prohibited.

### 2.3. Hazing methods previously applied

A variety of hazing methods had been applied in attempts to disperse the swallows and killdeer. Auditory frightening was conducted with pyrotechnics and propane cannons. Vehicular harassment was conducted along runways and included further auditory frightening with the use of sirens. Base personnel would also walk through runway areas and frighten birds. On occasion, limited shooting of birds was integrated with the other methods. Operational trials with MA were initiated because the hazing methods had been ineffective for lasting bird dispersal. Thus, hazing methods could not justifiably be applied as a basis for comparison with MA when operations and safety were at a premium at the airfield.

### 2.4. MA application

MA applications were made when BWCs due to swallow or killdeer numbers resulted in restricted operations, that is when BWC-Severe or BWC-Moderate conditions existed. Thus, time of MA application was variable according to when a hazard was designated. A commercially available, proprietary formulation of MA, Rejex-it<sup>®</sup> TP-40 (40% wt/wt MA), was applied using a Grizzly fogger (model series 422400, Clark Engineering Technologies). (Use of product names is strictly for identification purposes and does not imply product endorsement by the authors or USDA.) The equipment was set for an average droplet size of 15 µm. A 5–10 knot sea breeze was typical at the base, and fogging with MA was done on the upwind side of the airfield so that the MA plume would envelop the areas where birds were to be excluded. MA applications were initiated in the final quarter of 1997 and have continued to the present.

### 2.5. Data

Bird counts were made each day as one of the considerations for imposition of flight restrictions due to swallows and/or killdeer. For the same days, airfield tower records were examined to determine at what times flight restrictions were imposed due to swallow and/or killdeer numbers (BWC-Severe or BWC-Moderate), and at what times those restrictions were lifted (BWC-Low). Because comparative trials could not be conducted at an operational airfield, a descriptive assessment of MA efficacy was made, with the knowledge that the traditional hazing methods had never expeditiously dispersed the swallows and killdeer from the

Table 1

The days, bird numbers, times flight restrictions were implemented due to birds and the times those restrictions were lifted at Homestead Air Reserve Base, Florida during 2000

Date (in 2000)	Estimated # of birds	Times flight restrictions:		Minutes elapsed
		Implemented	Lifted	
3 May	300	11:58	12:34	36
5 May	450	11:20	12:40	80
6 May	600	10:57	11:14	17
11 May	400	10:47	11:35	48
16 May	300	11:00	11:24	24
20 May	250	11:25	12:05	40
23 May	450	11:01	11:40	39
24 May	300	11:20	12:01	41
3 Aug	500	12:43	13:37	54
5 Aug	400	11:52	17:40	348
10 Aug	500	11:14	13:57	163
24 Aug	450	11:22	14:58	216
Median	425			44.5

airfield in the past. Because bird numbers and dispersal times were asymmetrically distributed, nonparametric descriptive statistics were appropriately applied.

### 3. Results

Of the three species, barn swallows occurred most frequently and in the highest numbers, with as many as 4200 barn swallows observed on the airfield. The distribution of the numbers of birds was highly skewed; the median number observed on days where flight restrictions were enacted from 1998 to 2000 was 450, while the mean for the same days was 864. Unfortunately, tower records specifying the BWCs and the times they were implemented were only available for the year 2000. During 2000, the airfield was subjected to flight restrictions due to high numbers of swallows on 12 days (Table 1). The times at which airfield restrictions were implemented were between 10:45 am and noon for all but one day, where restrictions were implemented at 12:43 pm. MA was applied each day flight restrictions were imposed. The median number of birds at the time airfield restrictions were imposed in 2000 was 425. The median length of time until BWC-Low was designated for resumption of full operational ability was 44.5 min, and on 75% of the days BWC-Low resulted within 1.5 h of designation of restrictions.

### 4. Discussion

MA aerosol has been highly effective at Homestead Air Reserve Station for dispersing large numbers of swallows and killdeer from the flight lines in relatively short periods of time. Traditional hazing methods rely on visual or auditory stimuli, and prior to the use of MA-based aerosols, hazing by traditional methods, including occasional shooting, had

never succeeded in producing an effective dispersal of these birds from the airfield.

One interesting observation that aided in preparation for fogging was that 2–3 days in advance to an influx of large numbers of swallows, large numbers of dragonflies (order: Odonata) often would swarm the airfield. While the biological explanation of this phenomena (which we do not offer) might be fascinating, the practicality of the event was that it allowed time to prepare the fogging machinery and insure everything was in working order prior to the immediate need at the airfield.

The gentle sea breeze typical of the area facilitated application with the fogger. Situations without such a breeze, or with higher winds could increase the difficulty in successfully treating an entire area from which birds need to be excluded. In those situations, plume modeling software could be a useful tool for designing how application of MA-based aerosol could most efficiently be carried out for delivering adequate quantities for producing an aversive reaction by the target birds (Stevens and Clark, 1998).

Application of MA as an aerosol has been an effective, efficient and practical solution for dispersing large groups of swallows and killdeer from the airfield. Further operational trials are merited for dispersing other species in other airfield circumstances.

### Acknowledgements

K. Fagerstone, M. Fall, D. York, and two anonymous referees provided valuable reviews of earlier versions of the manuscript.

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